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Explosion protected, pressure-proof solenoid

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Patent Claims

1. Explosion protected, pressure-proof solenoid with a winding compartment, which is enclosed by a tubular cover belonging to the magnetic circuit and with a compartment for mounting circuit elements, characterized by the fact that the housing (3, 35) that encloses the mounting compartment (4, 34) for the circuit elements is attached to the cover tube (1, 40), that the mounting compartment is joined to the winding compartment (2) and that the mounting compartment together with the winding compartment is filled with a setting casting substance.
2. Solenoid according to claim 1, characterized by the fact that the cover tube (1) is extended beyond the winding compartment (2) on the side opposite to the drive side of the magnet and that the extension (3) of the cover tube encloses the mounting compartment (4) for the circuit elements (5).

3. Solenoid according to claim 1 and 2, characterized by the fact that the end of the cover tube (6) has a lid (7), which closes the mounting compartment, with openings (8, 9) for pouring in the casting substance and for connection glands (10).
4. Solenoid according to one or more of the previous claims, characterized by the fact that the outer side of the lid (7) forms the bottom of a terminal box (11).
5. Solenoid according to one or more of the previous claims, characterized by the fact that the wall of the terminal box is formed by a sleeve (12), which is slid over the cover tube (1) and welded to the cover tube.
6. Solenoid according to one or more of the previous claims, characterized by the fact that the armature mating piece (13) has a column-like extension (14), which penetrates the lid (7) of the mounting compartment (4) and serves to retain the terminal box lid (15).
7. Solenoid according to one or more of the previous claims, characterized by the fact that the housing (35) for the circuit elements is attached to the side of the cover tube (40).
8. Solenoid according to one or more of the previous claims, characterized by the fact that the housing (35) for the circuit elements (5) and the terminal box (37) form a single constructional unit (38).
9. Solenoid according to one or more of the previous claims, characterized by the fact that a partition (39) is provided in the constructional unit (38), which divides the mounting compartment (34) for the circuit elements from the rest of the terminal box compartment.

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Explosion protected, pressure-proof solenoid

The invention refers to an explosion protected, pressure-proof solenoid with a winding compartment, which is enclosed by a tubular cover belonging to the magnetic circuit and with a compartment for mounting circuit elements.

An explosion protected, pressure-proof solenoid is distinguished by the fact that sufficiently narrow and appropriately long gaps between the individual components which surround the inner compartment are associated with each of the inner compartments, in which explosions could occur in the case of a failure of an electrical component. It can then be relied upon that the flame of the explosion, if it has penetrated the gap, will have cooled down sufficiently and is no longer in a position to cause ignition outside the magnet.

Explosion protected, pressure-proof solenoids have become known in various forms of construction. Such a solenoid is described in DE-GM 1 773 817 where a solenoid in direct current design is fitted in a suitable outer housing. This outer housing has gaps of adequate length at the points of connection between the individual sections. The housing is a cast aluminum construction and threaded sleeves with female threads are set into the casting for the screws that join the individual components together and for fixing the housing to the component part to be driven. This results in a comparatively heavy design with relatively large dimensions.

Whereas in the aforementioned design the solenoid is completely encapsulated and enclosed on all sides by the pressure-proof housing, DE-GM 1 791 703 describes a form of construction in which the solenoid is slid into a housing and which protrudes partly from the housing on the drive side. But even this form of construction results in large external dimensions.

A form of construction is described in DE-GM 1 798 316 where the solenoid is likewise partly slid into a housing that has two compartments, of which the one compartment accommodates electronic components whereas the other compartment serves as a terminal box.

It is common with all known designs that relatively large external dimensions are obtained with pressure-proof solenoids on account of the requirements described above. It is clear that this makes the use of this type of solenoid not only more expensive but also more difficult because the space required on the component part to be driven is relatively large.

It is an objective of the invention to create a solenoid in an explosion protected, pressure-proof embodiment, which has significantly smaller external dimensions without this detracting from its ability to work. In particular, it is an objective of the invention to reduce the manufacturing outlay.

To solve this problem, the invention starts with an explosion protected, pressure-proof solenoid of the type described above and proposes that the housing, which encloses the mounting compartment for the circuit elements is attached to the cover tube, that the mounting compartment is joined to the winding compartment and that the mounting compartment together with the winding compartment is filled with a setting casting substance.

It has been found that with the proposal according to the invention, it is possible to create a mounting compartment for the circuit elements in an easy and comparatively inexpensive manner. All appropriate components are arranged in this mounting compartment, such as for example, varistors and diodes. Rectifiers can also be provided in the mounting compartment however in order to be able to connect a direct current magnet directly to the alternating current network. Other circuit components can also be accommodated in this compartment.

As the mounting compartment is joined to the winding compartment, this mounting compartment together with the winding compartment can be filled with a setting casting substance, for example a cast resin.

As a result of the filling process, all internal compartments are cleared of anything that could be the starting point for an explosion. Furthermore, there are no problems with covering the circuit elements to a sufficient depth with the casting substance so that safety is also provided in the case of a fault with these components.

The invention can be realized in various ways. In a preferred embodiment of the invention, the cover tube is extended beyond the winding compartment on the side opposite to the drive side of the magnet and the extension of the cover tube encloses the mounting compartment for the circuit elements. In this manner, a very simple, compact construction with small dimensions is achieved.

The invention particularly proposes that the end of the cover tube has a lid, which closes the mounting compartment, with openings for pouring in the casting substance and for connection glands. As a result of this, the explosion safety is further increased. The mounting compartment is securely covered and closed and favorable preconditions for the formation of a terminal box are also created, as advantageously the outer side of the lid forms the bottom of a terminal box.

This terminal box only accommodates components, which cannot be the cause of an explosion. An adequate closing off of the terminal box can thus be achieved with little effort. This does not exclude, in special cases, the provision of suitable means known in themselves for improving the safety requirements for the terminal box.

In itself, the terminal box could likewise be formed by an extension to the cover tube. However, it has been found that there is less effort required and better results are achieved when the terminal box wall is formed by a sleeve, which is slid over the cover tube and welded to the cover tube. The wall thickness of the sleeve can then be well matched to the conditions, which are stipulated for the details of a terminal box. An adequate sealing surface is thus obtained for the terminal box lid.

It is favorable if the armature mating piece has a column-like extension, which penetrates the lid of the mounting compartment and serves to retain the terminal box lid.

In another embodiment of the invention, the housing, which encloses the mounting compartment for the circuit elements is attached to the side of the cover tube. In particular, this housing forms a single constructional unit with the terminal box.

This and further characteristics of the invention can be seen from the drawing, which shows two embodiments of the invention in schematic form.

Fig. 1 shows a longitudinal section through a single stroke magnet in an embodiment of the invention,

Fig. 2 shows a part longitudinal section through a different embodiment of the invention and

Fig. 3 shows a side view of the embodiment according to Fig. 2 where the terminal box lid has been partly omitted.

The representation of a single stroke magnet is only to be understood by way of an example. The invention can easily be applied to a double, reversing or controlled magnet.

With the embodiment of the invention shown in Fig. 1, the cover tube has on its bottom end as shown in the drawing, which represents the drive side of the magnet, an insert piece 16, which makes the magnetic connection between the cover tube 1 and the armature 17. This armature is formed as a tapered armature with a tapered part 18. The threaded hole 19 serves to join the armature to the component part driven by the

armature. The grooved pins 20 join the insert piece 16 to the cover tube 1.

A partition plate 21 is inserted in the cover tube 1, which with 22 has a recess for feeding the connections through to the coil or winding 23, which is accommodated in the winding compartment 2.

The partition plate 21 also carries the armature mating piece 13 with the recess 24 which is matched to the tapered part 18 of the armature 17.

An armature guide tube 25 which, for example, can be made from a non-magnetic, non-rusting steel, stretches between the armature mating piece and the insert piece 16. This armature guide tube 25 can also be made up of several parts, which in itself is known. The use of a plastic tube for the armature guide tube is also possible for the invention as, due to the measures taken, it is not expected that there will be internal overpressures in the winding compartment 2 or the mounting compartment 4.

According to the invention, the cover tube 1 is extended beyond the partition plate 21 and this extension 3 of the cover tube encloses the mounting compartment 4. The circuit elements 5 can be arranged in this mounting compartment. For this purpose, a printed circuit board 26 is arranged in the mounting compartment, beneath which a frame 27 is provided for supporting the soldered joints. An insulating disc is shown as item 28.

The wiring and connections, which are not shown in detail, connect the winding 23 to the circuit elements 5. The connections are fed through the wiring gland 10 in the lid 7. This lid 7 is placed on the end 6 of the cover tube 1 or its extension 3 and closes the mounting compartment 4. Apart from the opening for the gland 10, the details of which can be better seen in Fig. 2, where the same glands are used, a further opening 8 in the lid 7 is provided, which advantageously can be used for filling. When filling, the mounting compartment 4 and the winding compartment 2 are filled at the same time with casting substance, in particular a cast resin, after all the components have been fitted and connected. Filling takes place under vacuum, for example, as is known in itself.

After completion of the filling process there are no longer any cavities inside the magnet.

The terminal box 11 is essentially formed by the sleeve 12, which is slid over the cover tube 1 and welded at 29. This terminal box 11 accommodates the connection terminals. The terminal box is closed by means of the terminal box lid 15, which lies on the edge of the sleeve 12. The associated seal is shown as item ~~15~~.

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The terminal box lid is retained by a screw 33, which engages with the column-like extension 14 of the armature mating piece 13. This column-like extension 14 is fed through the lid 7 of the mounting compartment and it is clear that the partition plate 21 and the lid 7 make a rigid support for the armature mating piece.

Furthermore, the terminal box 11 has the usual cable entry glands 31 and earthing terminals 32 and 36.

As, in the embodiment of the invention according to Fig. 1, the magnetic connection between the armature mating piece 13 and the cover tube 1 is not only formed by the partition plate 21 acting as a yoke but at the same time the lid 7 also has an effect, this can be taken into account accordingly when sizing the individual components.

In the embodiment according to Figs. 2 and 3 the housing 35 that encloses the compartment 34 for the circuit elements 5 combines together with the terminal box 37 to form one constructional unit 38. This constructional unit is attached to the side of the cover tube 40, for example by screws. The fixing screws for joining the constructional unit 38 to the cover tube 40 are shown by 41.

A partition 39 is provided in the constructional unit 38, which separates the compartment 34 for the circuit elements 5 from the remaining terminal box area. Furthermore, the compartment 34 also accommodates the glands 10. The glands are fixed by means of a screw 42 in the cover tube 40, a sleeve 43 surrounding the screw and a strap 44. In this manner, the glands 10 can be freely arranged in the compartment 34 and after the filling process a gap-free fixing of these glands can be achieved.

The mounting compartment 34 is connected to the winding compartment 2 by the channel 45 and the break-out 46 in the cover tube 40 so that all internal compartments can be filled in a single casting process. For this purpose, the casting substance is fed into the pouring hole 47 with a nozzle and fills first the winding compartment 2 and then the compartment 34.

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